NRE Staff Report

1979 FALL POTATO PESTICIDE USE
IN THE WESTERN REGION

by

John R. Parks

January 1982

ERS Staff Report No. AGES820108

Natural Resource Economics Division
Economic Research Service
U.S. Department of Agriculture
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ABSTRACT

A survey of pesticide use in fall potato production was conducted by the U.S. Department of Agriculture in 1979. Information on pesticide use is reported for Colorado, Idaho, Oregon, and Washington. An estimated 8.8 million pounds (active ingredient) of pesticides were used to control weeds, diseases, insects, and nematodes. Chemicals were also used to kill potato vines before harvest and to control the growth of sprouts on tubers in storage. More land area was treated with insecticides than any other category of pesticides. Of the 542,000 acres planted to potatoes in the Western region, 93 percent were treated with an insecticide. About 2 million acre-treatments were made with all pesticides, with 4.3 pounds (a.i.) applied per acre-treatment. Nematode control accounted for 60 percent of the quantity of pesticides; however, only 8 percent of the planted acres were treated. Coefficients of variation were calculated for acres treated with specific pesticides

Key words: Pesticides, potatoes (fall), herbicides, fungicides, insecticides, vine killers, growth regulators, Western region.

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1979 FALL POTATO PESTICIDE USE IN THE WESTERN REGION

INTRODUCTION

Presented in this report are the kinds and amounts of pesticides used on fall potatoes harvested in the Western region (Colorado, Idaho, Oregon, and Washington) in 1979 (Figure 1). Information is reported on treated acres, acre-treatments, quantities, and application rates.

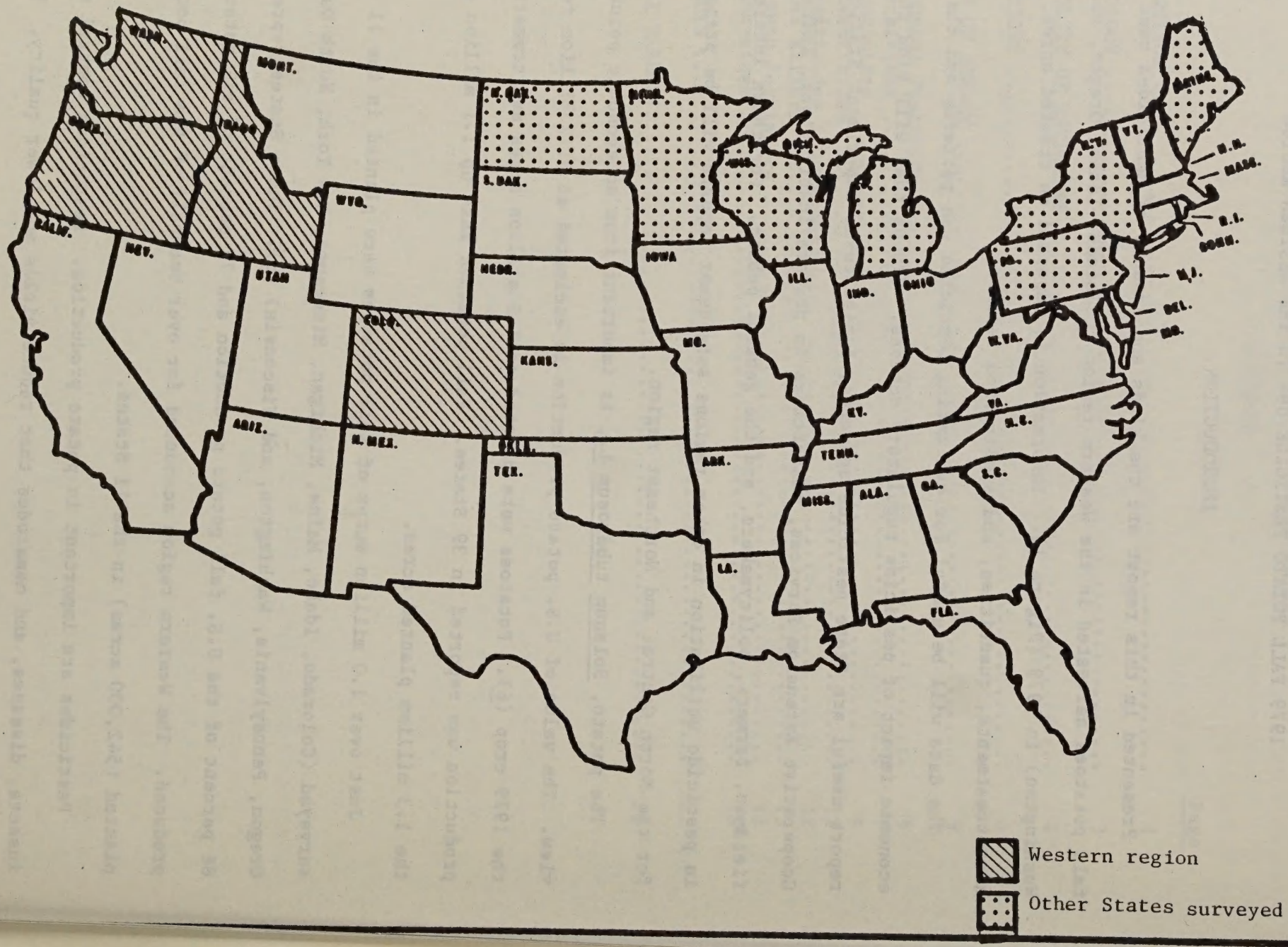
The data will be useful for evaluating pesticide use patterns and the economic impact of pesticide regulatory actions. Groups that will find this report useful are State pesticide agencies, Agricultural Experiment Stations, Cooperative Extension Services, researchers in private institutions, industry fieldmen, farmers, policymakers, and the general public. For those interested in pesticide utilization in other regions subsequent reports will be prepared for the North Central and Northeast region.

The potato, Solanum tuberosum L., is important from an economic point of view. The value of U.S. potato production is estimated at $1.2 billion for the 1979 crop (6). Potatoes were planted on 1.3 million acres and commercial production was reported in 39 States. Fall potatoes make up 1.1 million of the 1.3 million planted acres.

Just over 1.0 million acres of fall potatoes were planted in the 11 States surveyed (Colorado, Idaho, Maine, Michigan, Minnesota, New York, North Dakota, Oregon, Pennsylvania, Washington, and Wisconsin) (6). These States represent 86 percent of the U.S. fall potato production and 74 percent of all potatoes produced. The Western region accounted for over one-half of the fall potatoes planted (542,000 acres) in the 11 States.

Pesticides are important in potato production. Pesticides control weeds, insects, diseases, and nematodes that reduce yields and lower quality. From

Figure 1. States included in the 1979 Fall Potato Pesticide Survey.



a cost point of view they are an important consideration, because they account for 13 to 30 percent of total variable production costs in the Western region (1).

METHODOLOGY

Data in this report were collected in conjunction with the 1979 Potato Objective Yield Survey conducted by the Economics, Statistics, and Cooperatives Service of the U.S. Department of Agriculture. Enumerators from the State Statistical Offices (SSO's) collected the pesticide use data through personal interviews.

Sample design was a two-stage multiple frame sample. Sample fields were selected from a list of known growers (list frame) maintained by the SSO's. In addition, area tracts (area frame) were selected to insure that all growers had an opportunity to be included in the sample. Sample fields were randomly selected and the probability of being selected was proportional to field size. The selected sample size is related to the planted acres in each State. The expansion factor for the State is derived by dividing the planted acres by the number of usable questionnaires. Completed questionnaires obtained (664) represented 78 percent of the selected sample size.

State	Sample Size	Completed questionnaires
	No.	No.
Colorado	100	38
Idaho	360	318
Oregon	175	135
Washington	215	173
Total	850	664

RELIABILITY OF ESTIMATES

Estimates based upon sample surveys have varying degrees of statistical reliability. Confidence in data depends upon sample size, sampling methods, and the variability of the responses. To provide the user of the data with some indication of the reliability of the estimates, coefficients of variation (CV's) are presented in Appendix Tables 1 and 2. The CV is a measure of relative variation (expressed in percentage terms) and can be used to indicate the degree of confidence a user can place in the estimate. The smaller the CV, the more reliable the estimate.

In simplest terms, it can be said that there is 95 percent confidence that the sample represents the true population and that the true value for the population lies within an interval defined as $\pm$ 2 CV's times the estimated value. For example, with a CV of 10 and an estimate of 40, the interval would be 32 to 48. However, there is also a 5 percent chance that the true value does not fall within the interval as defined above because the sample is not representative of the population.

CV's were calculated only for acres treated with specific pesticides. The estimates of acres treated are expected to have greater variation than other data reported. Consequently, for most other information included in this report, the level of reliability should be equal to or greater than that reported for acres treated.

DEFINITIONS

For a clearer understanding of the data a number of terms are defined as follows:

Active ingredient - Pesticide quantities are expressed in terms of active ingredients (a.i.). This is the chemical substance that controls the pest.

Inert ingredients, such as talc, clay, or solvents are not included in the quantity estimates.

Times applied - The number of times a land area was treated with a specific pesticide.

Treated acres - The land area treated with a specific pesticide one or more times. Acres treated with different pesticides cannot be summed because a given land area may have been treated with more than one pesticide.

Acre-treatment - The acres treated with a specific pesticide times the number of applications. Since acre-treatments account for both the area and number of applications, acre-treatments with different pesticides can be summed without double counting.

Tank mix - Two or more pesticides mixed in the spray tank and applied in in a single application.

RESULTS OF SURVEY

General Pesticide Use

By category, insecticides were the most important pesticide used by potato growers in the Western region. Of the 542,000 acres of fall potatoes planted in this region, 93 percent were treated with insecticides (Table 1). However, in Colorado, growers treated only 74 percent of their potato acreage with insecticides.

Herbicides, the second most prominent pesticide category, were used on 78 percent of the planted acre and fungicides were third at 45 percent. Again, Colorado growers used fungicides more extensively and herbicides less extensively than the other States in the region. Other pesticides which were used included nematicides on 8 percent of the planted acres, vine killers on 29 percent and growth regulators on 3 percent (Table 1). Growth regulators

Table 1. Fall potato acreage and proportion treated with pesticides in the Western region, 1979 a/

State	Acres planted	Proportion treated with: Herbicides	Fungicides	Insecticides	Nematicides	Vine killers	Growth regulators
	1,000	Percent					
Colorado	40.0	18	79	74	0	16	3
Idaho	335.0	82	33	92	5	33	2
Oregon	65.5	80	62	96	14	22	6
Washington	102.0	90	60	99	20	20	5
Total	542.5	78	45	93	8	29	3

a/ "1979 Fall Potato Pesticide Survey," USDA, ESCS, Natural Resource Economics Division.

Table 2. Summary of pesticides used on fall potatoes in the Western region, 1979 a/

Pesticides	Acre-treatment	Quantity applied (a.i.): Total	Per acre treatment	Percent
	1,000	1,000 lbs.	Lbs.	
Single applications				
Herbicides	490.1	500.6	1.0	6
Fungicides	442.8	754.3	1.7	9
Insecticides	850.1	1,772.6	2.1	20
Nematicides	37.9	5,253.5	138.6	60
Vine killers	154.8	252.4	1.6	3
Growth regulators	15.7	50.9	3.2	<1
Tank-mixes	66.1	208.2	3.1	2
Total	2,057.5	8,792.5	4.3	100

a/ "1979 Fall Potato Pesticide Survey," USDA, ESCS, Natural Resource Economics Division.

reported in this survey are applied to the foliage during the growing season and inhibit sprouting in storage. This report does not account for growth regulators applied in storage such as chlorpropham (CIPC) and TCNB. Also excluded are products used for seed treatment and on facilities and equipment.

Potato growers in Colorado, Idaho, Oregon, and Washington indicated that they used almost 8.8 million pounds (active ingredient, a.i.) of pesticides in the production of fall harvested potatoes in 1979. Growers made close to 2.1 million acre-treatments averaging 4.3 pounds (a.i.) of pesticides per acre-treatment (Table 2).

Herbicides

Growers in the Western region made about 490,000 acre-treatments using 500,000 pounds (a.i.) of herbicides (Table 3). Metribuzin was used in more acre-treatments than any other herbicide reported; 64 percent of all acre-treatments. Metribuzin controls weeds such as velvetleaf, ragweed, pigweed, and cocklebur (2).

EPTC was the second most important herbicide with regard to acre-treatments and the most important with regard to number of pounds applied. About 240,000 pounds (a.i.) were applied in 83,000 acre-treatments (17 percent of all acre-treatments). It was applied at a rate of about 2.9 pounds (a.i.) per acre-treatment, the most for any herbicide used on potatoes. EPTC is a selective, preplant herbicide, applied prior to weed germination, and controls weeds such as nutsedge, barnyardgrass, and quackgrass (2).

Metribuzin was reported used in each of the four States in the Western region. In Idaho, 60 percent of the acres planted to potatoes were treated with metribuzin. Metribuzin is a relatively new herbicide compared with EPTC. It can be applied either as a preemergent or as a postemergent spray. As a postemergent application, its effectiveness is readily observed, a factor in

Table 3. Herbicide use on fall potatoes in the Western region, 1979 a/

State and pesticide	Treated acres b/	Acre-treatments	Quantity applied (a.i.) Total	Per acre Treated	Per acre Treatment	Times applied
	1,000	1,000	1,000 lbs.	Lbs.	Lbs.	No.
Colorado						
EPTC	3.2	3.2	11.2	3.5	3.5	1.0
Metribuzin	2.6	3.6	1.0	.4	.3	1.4
Total	-	6.8	12.2	-	1.8	-
Idaho						
Diphenamid	8.9	8.9	15.0	1.7	1.7	1.0
EPTC	47.9	47.9	130.6	2.7	2.7	1.0
Metribuzin	202.3	214.8	124.6	.6	.6	1.1
Trifluralin	28.1	28.1	15.9	.6	.6	1.0
Other	-	1.3	3.9	-	3.0	-
Total	-	301.0	290.0	-	1.0	-
Oregon						
Alachlor	2.5	2.5	6.8	2.7	2.7	1.0
Dinoseb	1.0	1.0	1.6	1.6	1.6	1.0
EPTC	6.4	8.6	22.0	3.4	2.6	1.3
Metribuzin	27.4	28.8	12.8	.5	.4	1.1
Trifluralin	20.6	21.6	10.5	.5	.5	1.0
Other	-	.9	2.6	-	2.9	-
Total	-	63.4	56.3	-	.9	-
Washington						
Dinoseb	7.7	8.9	22.0	2.9	2.5	1.2
EPTC	20.7	23.7	75.9	3.7	3.2	1.1
Metribuzin	56.0	65.5	30.9	.6	.5	1.2
Trifluralin	16.3	19.0	12.4	.8	.7	1.2
Other	-	1.8	.9	-	.5	-
Total	-	118.9	142.1	-	1.2	-
4 States						
Alachlor c/	4.4	4.4	11.3	2.6	2.6	1.0
Dinoseb	8.7	9.9	23.6	2.7	2.4	1.1
Diphenamid	8.9	8.9	15.0	1.7	1.7	1.0
EPTC	78.2	83.4	239.7	3.1	2.9	1.1
Metribuzin	288.3	312.7	169.3	.6	.5	1.1
Trifluralin	65.0	68.7	38.8	.6	.6	1.1
Other	-	2.1	2.9	-	1.8	-
Total	-	490.1	500.6	-	1.0	-

a/ "1979 Fall Potato Pesticide Survey," USDA, ESCS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Regional total differs from the sum for individual States because in some instances materials were included in the "other" category for State reporting.

its being widely adopted. EPTC must be soil incorporated, and controls the weeds before they are observed.

Growers in Idaho used more herbicides than those in the other States, accounting for 58 percent of the quantity of all herbicides used (Table 3). This is not surprising when one considers that Idaho has 62 percent of the acres planted to potatoes in the Western region.

Fungicides

Fungicides rank third in acre-treatments and quantity of pesticides used on potatoes, with just over 440,000 acre-treatments and 750,000 pounds (a.i.) applied (Table 2).

In terms of acre-treatments, maneb/mancozeb is the most extensively used fungicide. Maneb and mancozeb are very similar products with similar modes of action. For this report their data were combined and treated as a single item. Maneb/mancozeb accounted for 47 percent of all acre-treatments. Chlorothalonil was second at 18 percent, and sulfur third at 13 percent (Table 4).

Maneb/mancozeb is largely used to control or prevent early and late blight on potatoes. It is applied to foliage, and the extent of use is influenced by weather conditions that favor disease development (4).

Chlorothalonil controls early and late blight. Early blight is more of a problem in Idaho, where most of the chlorothalonil use was reported, than in Washington where little chlorothalonil is used.

Although sulfur is used in only 13 percent of the total acre-treatments, it accounted for 44 percent of the total quantity of fungicides used. It has been used for a number of years and has a variety of uses. Sulfur's continued use may stem from its wide spectrum of control and because it is relatively non-toxic to man (4). Washington has a problem with powdery mildew for which the growers usually treat with sulfur, often more than once per growing season.

Table 4. Fungicide use on fall potatoes in the Western region, 1979 a/

State and pesticide	Treated acres b/	Acre-treatments	Quantity applied (a.i.) Total	Per acre Treated	Per acre Treatment	Times applied
	1,000	1,000	1,000 lbs.	Lbs.	Lbs.	No.
Colorado						
Fentin hydroxide	3.2	3.2	0.8	0.2	0.2	1.0
Maneb/mancozeb c/	26.3	35.8	39.8	1.5	1.1	1.4
Sulfur	13.7	24.2	93.3	6.8	3.9	1.8
Total	-	63.2	133.9	-	2.1	-
Idaho						
Anilazine	7.1	9.7	7.4	1.1	.8	1.4
Captafol	11.7	19.6	21.7	1.9	1.1	1.7
Chlorothalonil	52.4	69.6	59.9	1.1	.9	1.3
Fentin hydroxide	9.3	13.2	3.4	.4	.3	1.4
Maneb/mancozeb c/	40.6	55.6	78.0	1.9	1.4	1.4
Metiram	1.4	1.4	2.3	1.6	1.6	1.0
Total	-	169.1	172.7	-	1.0	-
Oregon						
Captafol	20.0	20.5	29.3	1.5	1.4	1.0
Chlorothalonil	2.0	4.4	4.7	2.4	1.1	2.2
Fentin hydroxide	1.0	1.0	.1	.1	.1	1.0
Maneb/mancozeb c/	16.9	59.1	96.1	5.7	1.6	3.5
Other	-	2.6	1.1	-	.4	-
Total	-	87.6	131.3	-	1.5	-
Washington						
Captafol	7.7	16.7	16.2	2.1	1.0	2.2
Chlorothalonil	3.0	3.6	2.0	.7	.6	1.2
Fentin hydroxide	3.6	3.6	.4	.1	.1	1.0
Maneb/mancozeb c/	25.5	56.4	51.2	2.0	.9	2.2
Metiram	4.2	7.1	9.8	2.4	1.4	1.7
Sulfur	20.1	35.5	236.8	11.8	6.7	1.8
Total	-	122.9	316.4	-	2.6	-

-- continued

Table 4. Fungicide use on fall potatoes in the Western region, 1979 a/ -- continued

State and pesticide	Treated acres b/	Acre-treatments	Quantity applied (a.i.) Total	Per acre Treated	Per acre Treatment	Times applied
	1,000	1,000	1,000 lbs.	Lbs.	Lbs.	No.
4 States						
Anilazine	7.1	9.7	7.4	1.1	.8	1.4
Captafol	39.4	56.8	67.2	1.7	1.2	1.4
Chlorothalonil	57.4	77.6	66.6	1.2	.9	1.4
Fentin hydroxide	17.1	21.0	4.7	.3	.2	1.2
Maneb/mancozeb c/	109.3	206.9	265.1	2.4	1.3	1.9
Metiram	5.6	8.5	12.1	2.2	1.4	1.5
Sulfur	33.8	59.7	330.1	9.8	5.5	1.8
Other	-	2.6	1.1	-	-	-
Total	-	442.8	754.3	-	1.7	-

a/ "1979 Fall Potato Pesticide Survey," USDA, ESCS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Maneb and mancozeb are similar products; they are shown as one data entry.

Insecticides

Insects were the most pervasive pest problem in the Western region. More acres were treated with insecticides than any other pesticide category (Table 2). A wide variety of insecticides were used compared with other types of pesticides (Table 5). Of the many insecticides reported, aldicarb, disulfoton, methamidophos, and phorate were the most extensively used. Their use was in the range of 100,000 to 200,000 acre-treatments. They accounted for 77 percent of the 850,000 acre-treatments and 79 percent of the 1.8 million pounds (a.i.) of insecticides applied (Table 5).

Aldicarb was used in Washington to control aphids, mites, early generations of Colorado potato beetle, and, in some cases, nematodes. Disulfoton, which is not considered as effective against mites as aldicarb, is used in Idaho where mites are not as much of a problem. In Washington, where the growing season is longer than in other States, second generation insects build up and methamidophos is used for their control. Growers in Idaho may follow aldicarb or disulfoton applications with one treatment of methamidophos.

Average insecticide use rates per acre-treatment are fairly consistent across the four States in the Western region. The overall average was 2.1 pounds (a.i.) per acre-treatment, ranging from 1.9 pounds in Oregon and Washington to 2.5 pounds in Colorado (Table 5).

Nematicides (Fumigants)

Of the pest problems in the four States surveyed, nematodes are a minor problem. However, in localized areas root-knot nematodes can be a problem resulting in reduced potato grades and yields. Growers treated 20 percent of the planted acreage in Washington, and lesser amounts in Oregon and Idaho, with fumigants to control nematodes (Table 1). No nematicides were reported used in Colorado. Potato growers reported using 5.3 million pounds (a.i.) of

Table 5. Insecticide use on fall potatoes in the Western region, 1979 a/

State and pesticide	Treated acres b/	Acre-treatments	Quantity applied (a.i.) Total	Per acre Treated	Per acre Treatment	Times applied
	1,000		1,000 lbs.	Lbs.		No.
Colorado						
Endosulfan	25.3	30.5	22.8	0.9	0.7	1.2
Malathion	12.6	12.6	17.9	1.4	1.4	1.0
Parathion	2.1	3.2	2.1	1.0	.7	1.5
Sulfur	9.5	11.6	104.2	11.0	9.0	1.2
Total	-	57.9	147.0	-	2.5	-
Idaho						
Aldicarb	59.2	59.2	156.9	2.6	2.6	1.0
Azinphosmethyl	9.8	15.1	5.9	.6	.4	1.5
Disulfoton	151.5	154.1	424.4	2.8	2.8	1.0
Endosulfan	18.8	25.7	15.2	.8	.6	1.4
Fonofos	11.5	11.5	28.2	2.5	2.5	1.0
Methamidophos	37.3	43.5	37.7	1.0	.9	1.2
Phorate	69.9	69.9	198.2	2.8	2.8	1.0
Other	-	9.1	10.0	-	-	-
Total	-	388.1	876.5	-	2.3	-
Oregon						
Aldicarb	37.7	37.7	108.3	2.9	2.9	1.0
Azinphosmethyl	2.6	2.6	1.0	.4	.4	1.0
Disulfoton	3.3	3.3	8.1	2.5	2.5	1.0
Fonofos	31.1	31.5	67.7	2.2	2.2	1.0
Methamidophos	39.5	47.6	46.8	1.2	1.0	1.2
Parathion	2.5	2.5	2.3	.9	.9	1.0
Other	-	1.9	2.5	-	1.3	-
Total	-	127.1	236.7	-	1.9	-
Washington						
Aldicarb	73.5	74.7	209.5	2.9	2.8	1.0
Azinphosmethyl	5.4	6.1	4.3	.8	.7	1.1
Disulfoton	4.0	6.8	17.4	4.4	2.6	1.7
Fonofos	23.8	23.8	73.8	3.1	3.1	1.0
Methamidophos	66.0	124.4	117.5	1.8	.9	1.9
Parathion	1.2	2.4	1.3	1.1	.6	2.0
Phorate	31.0	32.8	83.4	2.7	2.5	1.1
Other	-	6.0	5.2	-	.9	-
Total	-	277.0	512.4	-	1.9	-

-- continued

Table 5. Insecticide use on fall potatoes in the Western region, 1979 a/ -- continued

State and pesticide	Treated acres b/	Acre-treatments	Quantity applied (a.i.) Total	Per acre Treated	Per acre Treatment	Times applied
	1,000	1,000	1,000 lbs.	Lbs.	Lbs.	No.
4 States c/						
Aldicarb	170.4	171.6	474.7	2.8	2.8	1.0
Azinphosmethyl	17.8	23.8	11.2	.6	.5	1.3
Disulfoton	158.8	164.2	449.9	2.8	2.7	1.0
Endosulfan	44.1	56.2	38.0	.9	.7	1.3
Fonofos	66.4	66.8	169.7	2.6	2.5	1.0
Malathion	12.6	12.6	17.9	1.4	1.4	1.0
Methamidophos	142.8	215.5	202.0	1.4	.9	1.5
Parathion	5.8	8.1	5.7	1.0	.7	1.4
Phorate	101.3	113.7	282.5	2.8	2.7	1.0
Sulfur	9.5	11.6	104.2	11.0	9.0	1.2
Other	-	16.6	16.8	-	1.0	-
Total	-	850.1	1,772.6	-	2.1	-

a/ "1979 Fall Potato Pesticide Survey," USDA, ESCS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

c/ Regional total differs from the sum for individual States because in some instances materials were included in the "other" category for State reporting.

soil fumigant in 38,000 acre-treatments. An average of 140 pounds (a.i.) were used per acre-treatment as compared with a range of 1.0 to 3.2 pounds (a.i.) for all other pesticides (Table 2). Three nematicides made up 96 percent of the total quantity applied: chloropicrin + dichloropropene (C/D), dichloropropene (D), and dichloropropane + dichloropropene (D/D) (Table 6). Soil fumigants are applied preplant to control nematodes. However, other pests such as certain weed seeds, soil insects, and fungal dieases are also controlled (3).

The most popular nematicide formulations vary by State: chloropicrin + dichloropropene is most widely used in Washington; dichloropropane + dichloropropene in Oregon; and dichloropropene in Idaho (Table 6). Washington is confronted with a dual problem of nematodes and verticillium wilt, which is partially a result of the long growing season. Chloropicrin + dichloropropene controls both of these pests. Idaho has a greater verticillium wilt problem and a lesser nematode problem than Washington. Idaho depends more heavily on dichloropropene to control verticillium wilt. Idaho's shorter growing season tends to limit nematode damage.

Vine Killers

Vine killers are used as a harvest aid. About two weeks before harvest the potato vines are sprayed, allowing the skin on the tuber to set, which facilitates machine digging. Of the total planted acres, 29 percent were treated with a vine killer (Table 1). Just under 155,000 acre-treatments were made (Table 7). Dinoseb was the most used chemical representing 89 percent of the total pounds (a.i.) and 92 percent of the acre-treatments. Other chemicals such as paraquat were also reported used as vine killers, but in small amounts. Vine killer use is somewhat dependent on the weather. If frost doesn't occur to kill the vines prior to harvest time, vine killers are used.

Table 6. Nematicide use on fall potatoes in the Western region, 1979 a/

State and pesticide	Treated acres b/	Acre-treatments	Quantity applied (a.i.) Total	Per acre Treated	Per acre Treatment	Times applied
	1,000	1,000	1,000 lbs.	Lbs.	Lbs.	No.
Colorado c/						
Idaho						
C/D d/	2.1	2.1	327.9	156.1	156.1	1.0
D/D e	.7	.7	147.9	207.0	207.0	1.0
D f/	6.4	6.4	805.4	125.7	125.7	1.0
Total	-	9.2	1,281.2	-	139.3	-
Oregon						
C/D d/	1.5	1.5	236.3	157.5	157.5	1.0
D/D e	4.5	4.5	956.7	213.5	213.5	1.0
D f/	2.4	2.4	347.8	146.1	146.1	1.0
Total	-	8.4	1,540.8	-	183.4	-
Washington						
C/EDB g/	2.0	2.0	109.3	54.7	54.7	1.0
C/D d/	7.2	7.2	1,021.0	141.8	141.8	1.0
D/D e/	5.7	5.7	697.4	123.3	123.3	1.0
D f/	4.2	4.2	484.5	115.4	115.4	1.0
Other	-	1.2	119.3	-	99.4	-
Total	-	20.3	2,431.5	-	119.8	-
3 States						
C/EDB g/	2.0	2.0	109.3	54.7	54.7	1.0
C/D d/	10.8	10.8	1,585.2	146.8	146.8	1.0
D/D e/	10.9	10.9	1,802.0	165.3	165.3	1.0
D f/	13.0	13.0	1,637.7	126.0	126.0	1.0
Other	-	1.2	119.3	-	99.4	-
Total	-	37.9	5,253.5	-	138.6	-

a/ "1979 Fall Potato Pesticide Survey," USDA, ESCS, Natural Resource Economics Division.
b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.
c/ Nematicide use not reported.
d/ Chloropicrin + dichloropropene.
e/ Dichloropropane + dichloropropene.
f/ Dichloropropene.
g/ Chloropicrin + ethylene dibromide.

Table 7. Vine killer use on fall potatoes in the Western region, 1979 a/

State and pesticide	Treated acres b/	Acre-treatments	Quantity applied (a.i.) Total	Per acre Treated	Per acre Treatment	Times applied
	1,000	1,000	1,000 lbs.	Lbs.	Lbs.	No.
Colorado						
Dinoseb	4.2	4.2	7.3	1.7	1.7	1.0
Other	-	2.1	3.4	-	1.6	-
Total	-	6.3	10.7	-	1.7	-
Idaho						
Dinoseb	101.2	102.5	136.9	1.4	1.3	1.0
Other	8.7	8.7	24.8	2.9	2.9	1.0
Total	-	111.2	161.7	-	1.5	-
Oregon						
Dinoseb	13.9	13.9	33.4	2.4	2.4	1.0
Other	-	.6	.3	-	.5	-
Total	-	14.5	33.7	-	2.3	-
Washington						
Dinoseb	21.0	22.2	45.9	2.2	2.1	1.1
Other	-	.6	.4	-	.7	-
Total	-	22.8	46.3	-	2.0	-
4 States						
Dinoseb	140.3	142.8	223.5	1.6	1.6	1.0
Other	-	12.0	28.9	-	2.4	-
Total	-	154.8	252.4	-	1.6	-

a/ "1979 Fall Potato Pesticide Survey," USDA, ESCS, Natural Resource Economics Division.

b/ Data in this column for "other" and "total" were not reported because two or more materials may have been used on the same acre resulting in multiple counting.

Growth Regulators

Growth regulators are used to inhibit sprouting in storage. The chemical sprayed on the potato plant in the field is maleic hydrazide (Table 8). It is the only chemical registered for use in the field. Chlorpropham (CIPC) and TCNB are also used as growth regulators. However, they are only applied to potatoes in storage and are not reported in this survey. In the Western region about 50 percent of the harvested production intended for the fresh or processing market is treated with CIPC (5). TCNB is a mild sprout inhibitor registered for use on seed potatoes that must sprout when planted.

Tank-mixes

Tank-mixes were of little consequence in potato production in the Western region. They make up 3 percent of all acre-treatments and 2 percent of the total quantity of pesticides applied (Table 2). There were 23 different mixes reported and no one tank-mix was used in more than one State in the region. Selected tank-mixes are shown in Table 9.

Table 8. Growth regulator use on fall potatoes in the Western region, 1979 a/

State and pesticide	Treated acres	Acre-treatments	Quantity applied (a.i.) Total	Per acre Treated	Per acre Treatment	Times applied
	1,000	1,000	1,000 lbs.	Lbs.	Lbs.	No.
Colorado						
Maleic hydrazide	- b/	-	-	-	-	-
Idaho						
Maleic hydrazide	6.0	6.0	17.1	2.9	2.9	1.0
Oregon						
Maleic hydrazide	4.1	4.1	18.5	4.5	4.5	1.0
Washington						
Maleic hydrazide	5.6	5.6	15.3	2.7	2.7	1.0
4 States						
Maleic hydrazide	15.7	15.7	50.9	3.2	3.2	1.0

a/ "1979 Fall Potato Pesticide Survey," USDA, ESCS, Natural Resource Economics Division.
b/ Data not reported because of a limited number of observations.

Table 9. Pesticides applied as tank-mixes to fall potatoes in the Western region, 1979 a/

Pesticides	Treated acres	Acre-treatments	Total Quantity Lbs. (a.i.)	State
		1,000		
Captafol	1.8	3.0	4.1	Washington
+ methamidophos			2.4	
Captafol	1.2	1.2	1.3	Washington
+ methamidophos			1.2	
+ sulfur			3.4	
Captafol	2.4	6.5	8.8	Washington
+ sulfur			23.9	
EPTC	2.4	2.4	3.3	Oregon
+ trifluralin			1.4	
Maneb	5.4	10.1	14.3	Washington
+ methamidophos			7.1	
Maneb	1.8	4.2	6.7	Washington
+ methamidophos			3.0	
+ sulfur			19.0	
Metallic copper	8.4	8.4	11.4	Colorado
+ zinc sulfate			11.4	
Methamidophos	1.2	2.4	1.8	Washington
+ metiram			1.9	
Methamidophos	1.2	2.4	2.4	Washington
+ metiram			3.8	
+ sulfur			6.6	
Methyl parathion	8.2	10.8	4.8	Oregon
+ parathion			9.6	
Metiram	2.4	2.4	4.3	Washington
+ sulfur			5.5	
Other b/	-	12.3	44.8	
TOTAL	-	66.1	208.2	

a/ "1979 Fall Potato Pesticide Survey", USDA, ESCS, Natural Resource Economics Division.
b/ Includes 12 separate combinations.

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Appendix Table 1. Coefficients of variation for potato acreage treated with selected pesticides by State and for the Western region, 1979 a/

Pesticide	Colorado	Idaho	Oregon	Washington	Region
	Percent				
Herbicide					
Alachlor	-	d/	39	d/	39
Dinoseb	48	9	16	12	7
Diphenamid	-	37	-	-	37
EPTC	56	14	26	15	10
Metribuzin	59	5	10	7	4
Trifluralin	-	19	13	17	10
Fungicide					
Anilazine	-	41	-	-	41
Captafol	-	33	13	27	13
Chlorothalonil	-	14	42	44	13
Fentin hydroxide	56	26	70	40	20
Maneb/mancozeb	12	16	15	13	8
Metiram	-	49	-	37	30
Sulfur b/	14	-	-	15	10
Insecticide					
Aldicarb	-	12	7	5	5
Azinphosmethyl	-	35	44	33	23
Disulfoton	-	7	37	37	7
Endosulfan	13	22	-	-	12
Fonofos	-	20	9	14	7
Malathion	24	-	-	-	24
Methamidophos	-	16	6	6	5
Parathion	70	-	44	70	35
Phorate	-	12	d/	11	9
Nematicides					
C/D	-	40	57	28	22
C/EDB	-	-	-	51	51
D	-	21	42	37	17
D/D	-	70	32	31	22
Vine killers					
Dinoseb c/	48	9	16	12	7
Growth regulators					
Maleic hydrazide	d/	30	28	31	18

- None reported.

a/ "1979 Fall Potato Pesticide Survey", USDA, ESCS, Natural Resource Economics Division. The coefficient of variation is the standard error of the estimate divided by acres treated times 100. The coefficient indicates the relative variation of the estimate. The higher the coefficient, the less reliable the estimate.

b/ Coefficient applies to all sulfur whether used as a fungicide or insecticide.

c/ Coefficient applies to all dinoseb whether used as a herbicide or vine killer.

d/ Use of this material at the State level was not significant.

Appendix Table 2. Coefficients of variation for potato acreage treated with selected pesticide tank-mixes by State for the Western region, 1979 a/

Pesticide	Colorado	Idaho	Oregon	Washington	Region
	Percent				
Captafol + methamidophos	-	-	-	57	57
Captafol + methamidophos + sulfur	-	-	-	70	70
Captafol + sulfur	-	-	-	50	50
EPTC + trifluralin	-	-	38	-	38
Maneb + methamidophos	-	-	-	33	33
Maneb + methamidophos + sulfur	-	-	-	57	57
Metallic copper + zinc sulfate	32	-	-	-	32
Methamidophos + metiram	-	-	-	70	70
Methamidophos + metiram + sulfur	-	-	-	70	70
Methyl parathion + parathion	-	-	23	-	23
Metiram + sulfur	-	-	-	50	50

- None reported.

a/ "1979 Fall Potato Pesticide Survey", USDA, ESCS, Natural Resource Economics Division. The coefficient of variation is the standard error of the estimate divided by acres treated times 100. The coefficient indicates the relative variation of the estimate. The higher the coefficient, the less reliable the estimate.